



## **NASA SBIR 2006 Phase I Solicitation**

### **X3.01 Spacecraft Cabin Atmospheric Management and Habitation Systems**

**Lead Center:** JSC

**Participating Center(s):** ARC, GRC, JPL, KSC, MSFC

Atmospheric management and habitation systems supporting critical needs for lunar mission architectures are requested. Vehicles and habitats are expected to be significantly restricted with respect to habitable volume and may operate at reduced atmospheric pressure with elevated oxygen concentrations. Improved non-regenerative and regenerative processes technologies for atmospheric quality control must be developed. The ability to economically supply atmospheric gases and refill storage tanks in flight will be needed. Isolating habitable volumes from surface dust and disposing of accumulated particulate matter will be challenges. Habitation systems must be innovative, extremely space efficient, and re-configurable (dual or multi-use).

#### **Atmospheric Management**

Atmospheric management encompasses the range of process technologies and equipment to remove impurities and condition crewed spacecraft and habitat cabin atmospheres, supply and store atmospheric gases, and achieve mass closure by recycling resources and using in situ resources. Process technologies typically involve separations and reactions. Separations-based processes include physical adsorption, absorption, and mechanical filtration processes. Reaction based processes include chemical adsorption, oxidation, and reduction. Techniques for enhancing NASA's present capabilities are sought. Areas of emphasis include:

- **Atmospheric Purification and Conditioning:** Process technologies for single and dual function atmospheric purification and conditioning based on novel embodiments of commercially available adsorbent, chemisorbent, and catalyst media are required. Novel engineered media substrates to enhance durability, energy efficiency, and mass transfer leading to increased reliability, functional capacity, and smaller size relative to NASA's existing experience are sought. Specific challenges exist for efficiently removing ammonia, formaldehyde, and carbon monoxide from cabin atmospheric gases using process technologies that can be regenerated in place. Process technologies for removing and sequestering carbon dioxide from cabin atmospheric gases via means other than adsorption or chemisorption and conditioning carbon dioxide for use in reduction processes to facilitate cabin mass balance closure are also of interest.
- **Supply and Store Atmospheric Gases:** Novel means for supplying and storing oxygen and nitrogen under sub-critical conditions that lead to enhancements in energy efficiency, reduced mass and volume, and mission flexibility are sought.
- **Recycle Resources and Use In Situ Resources:** Novel means for supplying atmospheric gases using gas

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purification process waste products or means to more directly couple carbon dioxide and moisture removal to extract usable oxygen are sought.

### **Dust Control and Abatement**

Dust and particulate matter contamination are challenges that must be overcome for lunar and Mars surface exploration. Particulate contamination originating from the external surface environment or from internal sources are both of concern. Development of regenerable process technologies and equipment to minimize the impacts of surface dust on crew health and life support equipment are sought. Novel approaches to isolate habitable volumes from surface dust and to remove dust from the spacecraft atmosphere, space suits and equipment are sought. Candidate technology solutions should provide high efficiency, long-lived removal capacity and be amenable to regeneration in place. Areas of emphasis include:

- **Particulate Matter Removal and Disposal:** Process technologies for removing and disposing of surface dust and particulate matter are sought. Salient features for this application include capability for regeneration in place, long-lived removal capacity and high efficiency.
- **Isolation Technologies:** Process technologies and design concepts to isolate habitable volumes from surface dust are sought. Such process technologies and design concepts may employ a variety of techniques to prevent surface dust from being transported through an airlock into the habitable part of the spacecraft or habitat cabin.

### **Habitation Systems**

Habitation systems include crew accommodations, provisions, housekeeping and crew interfaces with vehicle systems including life support. Products can include applied research, system analysis, mockup evaluation, functionality demonstrations/tests, and actual prototype hardware. Proposals may address the following considerations and themes: re-configurable crew volumes and work stations for multi-gravity environments (micro and reduced gravity), multi-use work stations, multi-gravity translation strategies, physically and psychologically ergonomic personal volumes, automated deployment, quiescent operations between missions, multi-purpose stowage systems, advanced hygiene systems, automated housekeeping, and commonality of hardware/systems. Specific areas in which advanced habitability system innovations are solicited include:

- **Crew Hygiene Systems:** Low maintenance/self-cleaning fecal, urine, menstrual, emesis, hand/body wash, and grooming systems. Specific areas include non-foaming separators and no-rinse/non-alcohol hygiene products. Toilet systems should consider air, liquid, vacuum, and low-gravity transport methods. Collected waste should be prepared for recovery or long-term stabilization. Integrated hygiene systems should provide acoustic and odor isolated private crew volumes compatible with multi-gravity interfaces.
- **Crew Accommodation Systems:** Reconfigurable, deployable, erectable, or inflatable integrated crew accommodations that support crew wardroom, dining, conference, sleeping, relaxation activities and or stowage. May include visual and acoustical isolation, illumination, quiet ventilation/thermal control, audiovisual communication/entertainment, and off-nominal uses (emergency medical or repair) while maintaining hygienic conditions. Stowage systems may include interior/exterior stowage systems for partial gravity environments that maximize usable volume and include contents identification and inventory control systems.
- **Clothing Systems:** Low mass reusable or long usage clothing options that meet flammability, out gassing, and crew comfort requirements. Cleaning and drying systems for re-use of clothing that have low-water usage, non-toxic cleaning agents compatible with physicochemical or biological water reclamation systems, or that do not require water.

